

## Does the Brazilian soybean production increase pose a threat on the Amazon rainforest?



**Brazilian Agricultural Research Corporation  
Embrapa Soybean  
Ministry of Agriculture, Livestock and Food Supply**

## **DOCUMENTS 414**

# **Does the Brazilian soybean production increase pose a threat on the Amazon rainforest?**

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2019

Copies of this publication can be acquired at:

**Embrapa Soja**  
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CEP 86001-970  
Distrito da Warta  
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#### **1<sup>st</sup> edition**

Digitalized PDF (2019).

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**International Cataloging in Publication (CIP) Data**  
Embrapa Soybean

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Gazzoni, Décio Luiz

Does the Brazilian soybean production increase pose a threat on the Amazon rainforest? / Décio Luiz Gazzoni, Alexandre José Cattelan, Marco Antonio Nogueira. – Londrina: Embrapa Soybean, 2019.

PDF (31 p.) : il. (Documents / Embrapa Soja, ISSN : 2176-2937 ; n. 414).

1.Soja-Produção. 2.Cattelan, Alexandre José. 3.Nogueira, Marco Antonio. 4.Título. I.Série.

CDD: 633.34 (21.ed.)

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## Presentation

The mission of Embrapa has a unique commitment, which is the technological development strongly linked to sustainable solutions. This vision has been a constant throughout its 46 years of existence, reflecting a position of the Government, a yearning of the society and a posture of the Brazilian farmers. Sustainability implies better agricultural practices, more environmentally friendly, with respect to the condition of the workers in agriculture, and that allow the adequate return to the farmer's investments. This vision applies to all cultures, husbandry and regions where Embrapa operates.

Nevertheless, due to the extension of the area currently occupied - about 36 million hectares - and to the perspectives of strong demand in the coming decades, soybean production is the most challenging, requiring increasing attention not only from Embrapa, but also from all public and private sectors, involved with Brazilian agriculture.

At the United Nations Conference on Sustainable Development (Rio+20), held in Rio de Janeiro, Brazil (June 2012), Member States adopted the outcome document "The Future We Want". As a result, it was decided, among other resolutions, to launch a process to develop a set of Sustainable Development Goals (SDGs) to build upon the Millennium Development Goals (MDGs) and to establish the UN High-Level Political Forum on Sustainable Development.

Brazil is fully aware of its commitment to the UN's 17 SDGs, reflected in public policies and attitudes aimed at eliminating illegal deforestation and drastically reducing greenhouse gas emissions. To do so, Brazil has the most severe forestry legislation in the world, imposing restrictions on land use change that have no parallel in other countries. For this reason, Brazil uses only 7.8% of its territory for agriculture, preserving almost nine times more area. Embrapa demonstrated that Brazilian growers preserve inside their properties, at their own costs and responsibilities, 25.6% of the Brazilian territory, which is far superior to most other countries.

This publication has the specific objective of demonstrating that there is no risk of the Amazon forest being threatened by deforestation as a consequence to the need of expand soybean production in Brazil, either due to short-term circumstances - such as the tariff war between the United States of America and China - or by market factors as long-term demand. This is because all sectors involved with the soybean production chain in Brazil, public or private, have a clear agenda that foresees the sustainable advancement of soybean production in Brazil. This advance will occur primarily in anthropic areas, especially those currently occupied by pastures – liberated by the continuous improving of the zootechnical parameters -, and by the increase of soybean productivity. Definitively, Brazil will not admit illegal deforestation in any biome, for occupation by agricultural activities.

*José Renato Bouças Farias*  
Head General, Embrapa Soybean

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## Introduction

Many articles in the international press and even scientific papers have questioned the sustainability of the soybean production in Brazil. Many infer that the increase in production is directly proportional to the increase in the Amazon rainforest deforestation. One example of this is the comment “*Why the US–China trade war spells disaster for the Amazon*” (Fuchs et al., 2019) published in the online edition of Nature (March 27, 2019). The authors concluded that “*Governments, producers, regulators and consumers must act now. If they don’t, the Amazon rainforest could become the greatest casualty of the US–China trade war.*” The present article seeks to shed light on this discussion by bringing consistent data on the subject.

In order to contextualize the US–China tariff war scenario, the following considerations must be taken into account:

- Analysts agree that impacts on the soybean market should take June 2018 as the base line, when the new tariffs and rules turned into effect.
- The peak on US soybean exports to China occurred on the 2016/17 season, consisting of 36 million metric t (Mt) (United States, 2019a).
- During the 2019 season, to end in next September, the US still exported 10 Mt (United States, 2019a).
- Considering the worst case (no more soybeans exported from US to China along this season), the discussion will restrict to less than 26 Mt, as China is reducing its soybean import for several reasons (not because the tariff war).
- The 26 Mt of soybeans exported represents roughly 7% of the global production in the last season (United States, 2019a).
- This amount of soybean would demand ca. 7.5 Mha, considering the Brazilian yield in 2018/19 season (Conab, 2019a).
- For comparative purposes, the Brazilian Amazon covers more than 4,196 Mha (Brasil, 2019).

In this article, we discuss the impact of the so-called “US-China tariff war” on the international soybean market and other similar allegations that soybean production in Brazil is not sustainable, and present several reasons why the soybean production will not affect the Amazon Forest, as the country has been prepared to continue increasing its production (not depending on short range interurrences like the tariff war), based on sound sustainable production systems, regulations and processes.

## Restrictions for soybean cropping in the Amazon Biome

The Brazilian legislation that regulates the private land use and conversion is called Código Florestal (Forest Code), consubstantiated on the Federal Law 12.651, issued by the National Congress on May 25, 2012. According to the Law, a private land owner can not use more than 20% of its property in the Amazon Biome, for agricultural or other objective, not considering the Permanent Preservation Areas (riverbanks or any water course, hillsides or mountain tops, wetlands, etc.). For example, a property with total area of 100 ha, where 20 ha constitute Permanent Preservation Area, can only use 16 ha (20% of the remaining 80 ha) for any land use. The rest of the property should be kept with native vegetation under the penalties of the law. According to the Brazilian law (the strictest in the world according to Chiavari; Lopes, 2019) it is perfectly legal to deforest those 16 ha.

To demonstrate their commitment with the preservation of the Amazon Biome, private sector traders set even more restrictive standards, not even accepting deforestation legally allowed by the Brazilian law. That is specifically the case of the Soybean Moratorium, a private initiative created in 2006, sponsored by the Brazilian Association of Vegetable Oil Industries (ABIOVE) and the National Association of Cereal Exporters (ANEC), which together account for the commercialization of more than 90% of the soybean produced in Brazil. The initiative has pledged not to buy or finance soybean crops established in the Amazon Biome after 2008.

Nearly 100% of the Brazilian soybean produced in the Amazon Biome is being monitored by this initiative. The surveillance is aided by the National Institute of Space Research (INPE), which through periodic satellite images can iden-

tify soybean farms with more than 25 ha that violate the Moratorium (Kastens et al., 2017).

As a result of the Soybean Moratorium, during the last 11 years, soy plantations that do not comply with the Moratorium directives were identified on just 64,316 ha illegally deforested between 2009 and 2017, which represent roughly 0.17% of the Brazilian soybean area. Growers that cultivate those 64 kha face tremendous problems for buying inputs and selling their production, as none of the traditional traders accept the soybean that do not comply with the Soy Moratorium (Abiove, 2019).

Considering the 26 Mt of soybean impacted by the US-China tariff war in the global market, and the unlikely use of 0.18% of the Amazon Biome for its additional cultivation, this is not a concrete fact inducing a surge of tropical deforestation as a result of the demand being placed on the major suppliers to eventually substitute US soybean exports to China.

Other fundaments supporting this affirmative are based on market mechanisms and logics, soybean historical data and, specially, on how Brazil and the soybean growers will approach the projected future demand on soybean products - and this does not mean only China's demand or substitution of suppliers.

Brazil has projected the scenarios of the international soybean market for the next decades and how to approach it in a sustainable way (Gazzoni; Dall'Agnol, 2018). Cultivating soybean in the Amazon Biome is out of all considered sceneries, due not only to environmental concerns and legal restrictions, but also for economics, logistics, practical, technical and financial reasons.

## Markets always seek equilibrium

Natural market rules point to equilibrium and rationality. Some imbalances might occur on the short range – as is the case of the present dispute for tariffs and quotas. Focusing on the medium and long range, the market is always seeking to fine-tune the balance between demand and supply. One indicator of this equilibrium is the relationship between ending stocks and production. If the stocks go down, demand is greater than supply; the reverse is true if stocks are up. Table 1 shows that the proportion of ending stocks over total

production has increased along the previous seasons, but remained almost stable between 2017/18 and 2018/19 seasons. These figures indicate a stable or demand-excess market, even after the new Chinese tariffs on the US soybean exports were applied.

**Table 1.** Global soybean production, ending stocks and proportion of ending stocks over production.

Factor	Unit	2014/15	2015/16	2016/17	2017/18	2018/19
Production (A)	Mt	321	317	349	340	361
Stocks (B)	Mt	79	80	96	99	107
B/A	%	24.6	25.2	27.5	29.1	29.6

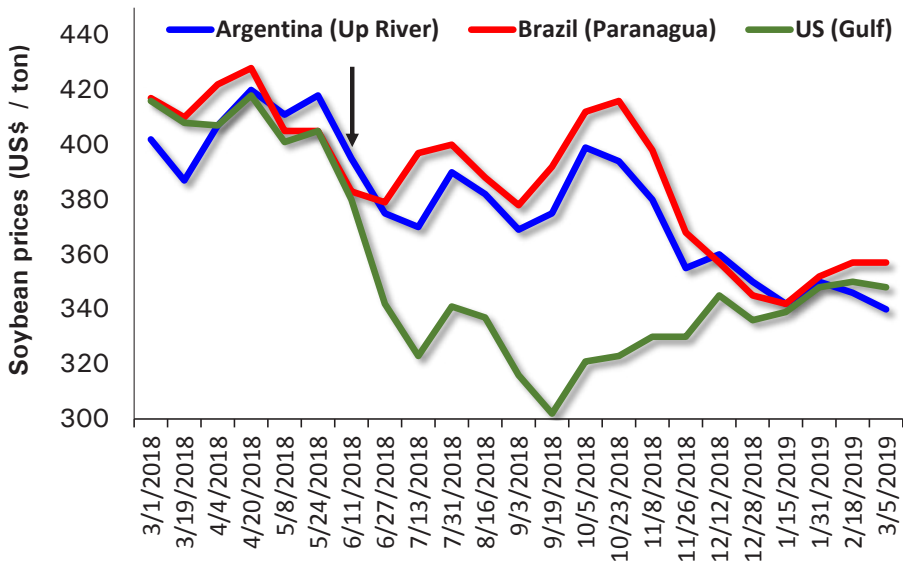
Source: United States (2019a).

Stocks may go up or down due to short range or structural reasons, which are clarified and screened by market mechanisms and afterwards transmitted to the prices. This is the primary sign for growers: prices up stimulate production; inversely, prices down inhibit it.

It is important to identify if a price sign is anchored on conjunctural or structural reasons. In this last case, the sign sent to the growers is a trend indicating a long range new production ceiling. In the case of short-range unbalance – as in the China x US dispute – there are other market mechanisms to solve it and rearrange the trade of a given commodity. That is why Figure 1 shows positive premiums for Argentinian and Brazilian soybeans compared with the US, but restricted from June to November 2018. It must be considered that higher tariffs were imposed in June (identified by the arrow on Figure 1), but by November the market absorbed the fact and went back to normal relative prices.

For short range, limited unbalances, the main market adjustment mechanism is a redistribution of the network between suppliers and consuming countries. If a given country decides not to import from one of its traditional suppliers, then it will look for substitute supplier(s) – given that not only bilateral, blocks and multilateral treaties but also the World Trade Organization rules have to be observed. In the case of establishment of new trade contracts, these suppliers, at first, will not increase its production (because the sign does not

involve a new demand plateau by itself); they will only rearrange its export fluxes. In the end, new trade fluxes will be established, with a rearrangement between exporting and importing countries.

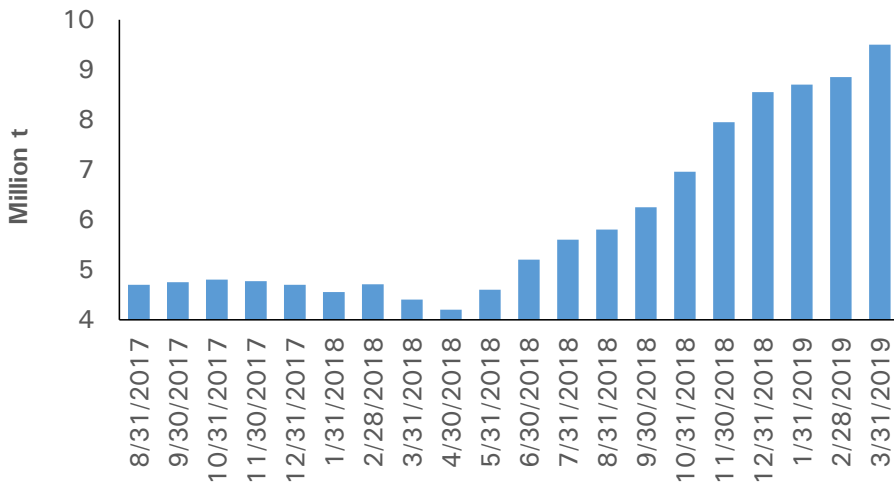


**Figure 1.** Soybean export prices.

Source: United States (2019a).

## The soybean market is now adapting to the tariff war

The signs that the soybean international market is seeking for accommodation to overcome an eventual prolonged China x US tariff war are getting clearer. Above all, the US will never reduce its soybean production in the same amount of frustrated exports to China that could lead to an equivalent increase in the production by other countries. Instead, the US will maintain its soybean production with sound financial government support (United States, 2019b) and look for other partners, like expanding its exports to the European Union, the second largest global soybean importer. If Brazil is to redirect its exports to China, a market opportunity opens with EU, quickly captured by the US, as demonstrated in Figure 2.



**Figure 2.** 12-month moving-total of US soybean exports to the European Union.

Source: United States (2019a).

Secondly, China is reducing its soybean imports, for several reasons, but specially because the country is facing a reduction in its pig production due to sanitary reasons. Pig production is one of the major drivers for Chinese soybean imports. Less pork meat production in China is leading to larger imports of pork meat – chiefly from the US. Pork meat exports from US to China are projected to increase from 100 kton (2018) to 300 kton (2019) (Bloomberg, 2019).

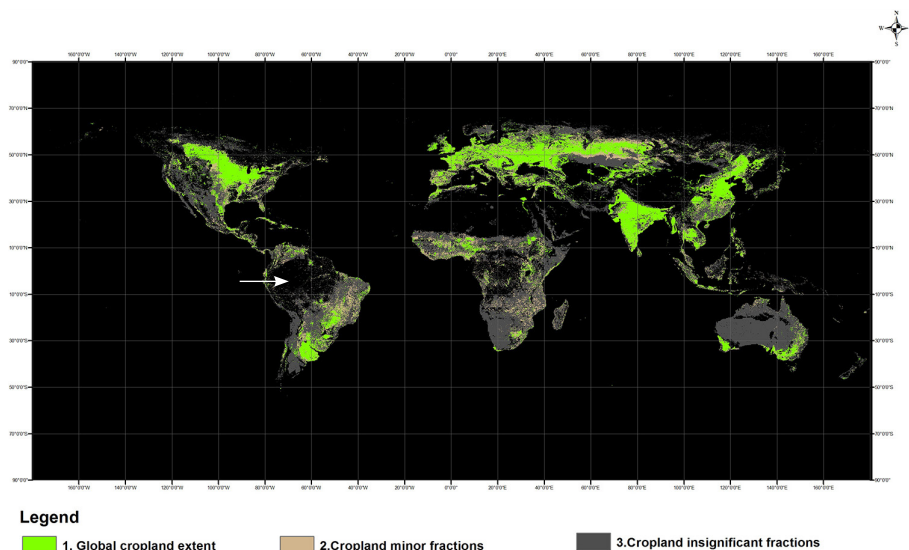
Ironically, part of the soybean that would be exported by the US as grain will reach China with added value, as pork meat. Importing pork meat from the US means less soybean importation from other suppliers. This market movement helps mitigating the impact of the tariff war, giving the necessary time and tranquility to market mechanisms to accommodate, if an eventual structural change of market fluxes becomes permanent.

Thirdly, Canada dramatically incremented by 80% its soybean exports to China in recent months, partially substituting US exports (Powell, 2019).

## Worldwide agricultural area

The NASA-funded GFSAD30 project resulted in databases and maps, in which the Earth's surface was scanned in 30 m<sup>2</sup> resolution, during two decades (USGS, 2019a). According to the study, the world has 1.87 billion hectares (Gha) of crops (Figure 3). The largest cultivated areas are located in India (179.8 million hectares - Mha), United States (167.8 Mha), China (165.2 Mha) and Russia (155.8 Mha). One of the applications of the study is the possibility of identifying which countries can possible expand the agricultural frontier in a sustainable way, if it did not reach or surpassed a reasonable proportion between agricultural area and native vegetation.

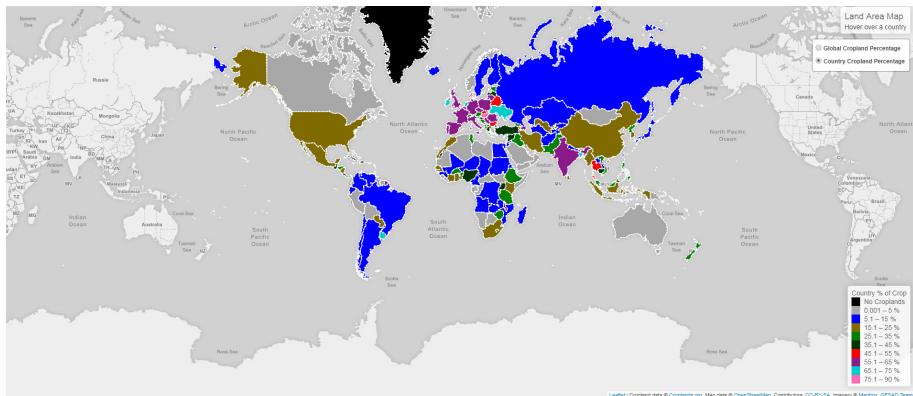
The results of this study are very close to those published in 2018 by Embrapa Territorial (Embrapa, 2019a), which calculated the cultivated area of Brazil in 65,913,738 ha, equivalent to 7.8% of its territory. The GFSAD30 project estimated the area of crops in Brazil at 63,994,479 ha (7.6% of the territory), a small difference. It is possible to clearly identify in Figure 3 that the Amazon region (arrow) is outside of the cropped area and involves not only Brazil, but also Peru, Colombia, Venezuela, Guyana, French Guyana, and Suriname.



**Figure 3.** World distribution of land used for agricultural purposes in 2017.

Source: USGS (2019a).

Brazil cultivates 7.6% of its area and protects or preserves almost nine times more (66.3 % of its territory). Just for comparison purposes, Denmark cultivates 76.8% of its area; Ireland, 74.7%; the Netherlands, 66.2%; United Kingdom 63.9%, and Germany 56.9%. The use of farmland is not different in the rest of Europe, with agriculture using 55-65% of the territory for the majority of the countries, according to GFSAD30 (Figure 4).



**Figure 4.** Cropland areas as a percent of the country geographic area.

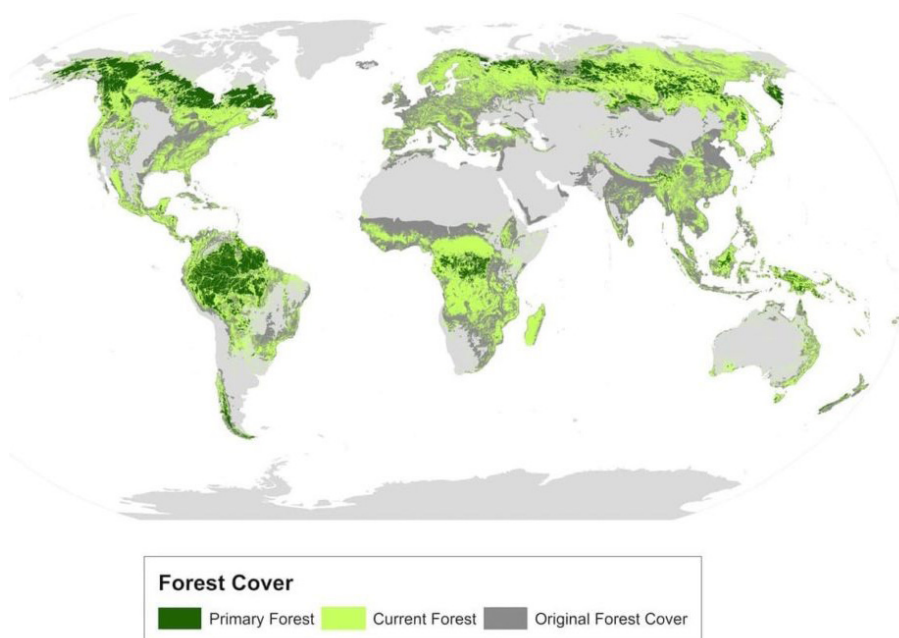
Source: USGS (2019b).

According to the Food and Agriculture Organization of the United Nations, the four countries with the largest primary forest area are Brazil (495 Mha), Canada (330 Mha), USA (280 Mha), and China (145 Mha) (FAO, 2015). The location of world's primary forests is shown on Figure 5.

A recent study comparing the legislation regarding native forests protection indicated that Brazil has the most rigorous rules, the only one obligating farmers to preserve native vegetation at their own expenses and responsibilities, one of the key reasons for the country showing up the world highest level of primary forest preservation (Chiavari; Lopes, 2019).

Brazilian growers preserve 25.6 % of the Brazilian territory (ca. 219 Mha) at their own costs and responsibilities. Embrapa estimated the value of this area in the land market as over US\$ 627 billion. If the growers were not legally forbidden to cultivate this area, their yearly estimated additional gross income would be over US\$70 billion (Embrapa, 2018).





**Figure 5.** Location of primary forests around the world.

Source: International Action for Primary Forests (2019).

As a rule, Europeans deforested their territory in order to exploit it intensely and not only for agricultural use, but also for urban, road or industrial occupation. Prior to intensive exploitation, Europe (excluding Russia) represented more than 7% of the world's original forests, while Brazil had 9.8%. Today, Europe has only 0.3 % while Brazil has 28.3 % of the world's forests (World Resources Institute, 2019). As an example, in 2016 France (28.7 Mha), Spain (26.3 Mha), and Germany (16.7 Mha) (World Bank, 2019a) together cultivated 13% more area than Brazil. However, the sum of the total area of the three countries represents only 16.7 % of Brazil's territorial area (World Bank, 2019b), meaning that the pressure of agriculture on the environment is far higher in those countries than in Brazil.

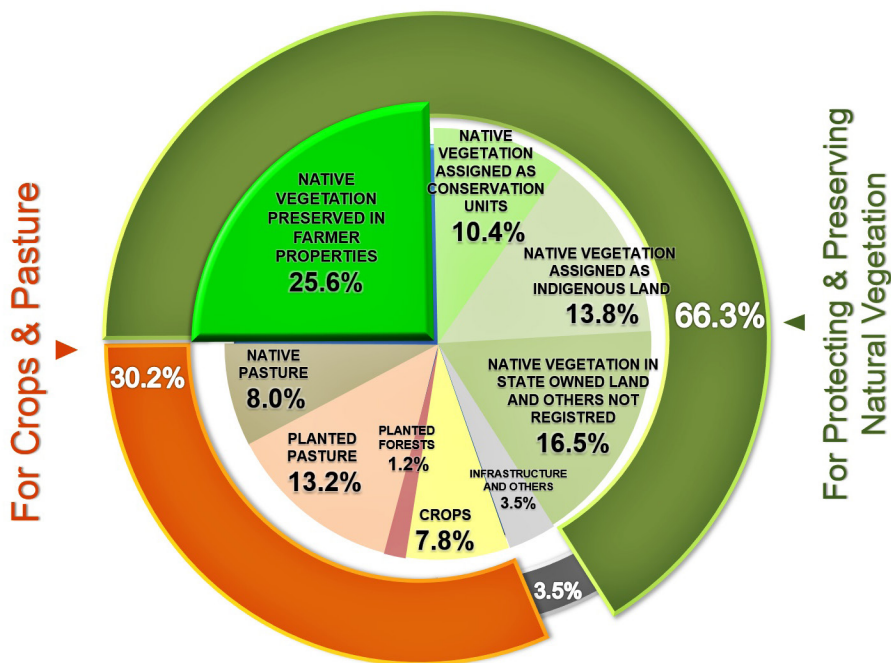
## Sustainable agriculture in Brazil

After these market and agriculture introductory considerations, it is important to understand how Brazilian growers and the Government will behave in order to keep pace with the sustainable development targets, according to the country commitments on international fora and with the recent history of Brazilian agriculture.

The land use and occupation in Brazil, as for 2017, is presented in Figure 6. Considering all preserved areas (On-farm, Indian lands, Conservation Units and Government owned), Brazil preserves 66.3% of its territory, whose original vegetation has remained untouched for millennia (Embrapa, 2019a).

The Brazilian law severely restricts any use of the area in a farm, no matter if it is for agriculture or other use. According to the Brazilian Federal Law 12.651/2012 (Brasil, 2012), a farmer can only use up to 20% of the area of its property if it is located in the Amazon Biome; 65% in the Cerrado Biome; and 80% in the Atlantic Forest and Pampas Biomes. The farmer is responsible for preserving the native vegetation in the rest of the farm, under the penalties of the law, specially the so-called Permanent Preservation Areas (border of rivers, lakes and other water sources, top and slope of hills of high declivity, etc.), and the Legal Reserve, a forest reservoir.

Considering these aspects, sometimes a grower is enforced by law to preserve more than the legal minimum limits described above. Even for the legally permitted deforestation of a farm, the process is bureaucratic, tiresome and the permit is difficult to obtain, but is always required prior to changing the land use from native vegetation to other purposes. Brazilian growers preserves 25.6 % of the Brazilian territory at their own costs and responsibilities (Figure 6). Embrapa estimated the value of this area in the land market as over US\$ 627 billion. If the growers were not legally forbidden to cultivate this area, the yearly estimated gross income would be over US\$ 70 billion.



**Figure 6.** Use and occupation of the Brazilian land.

Source: Embrapa (2019a).

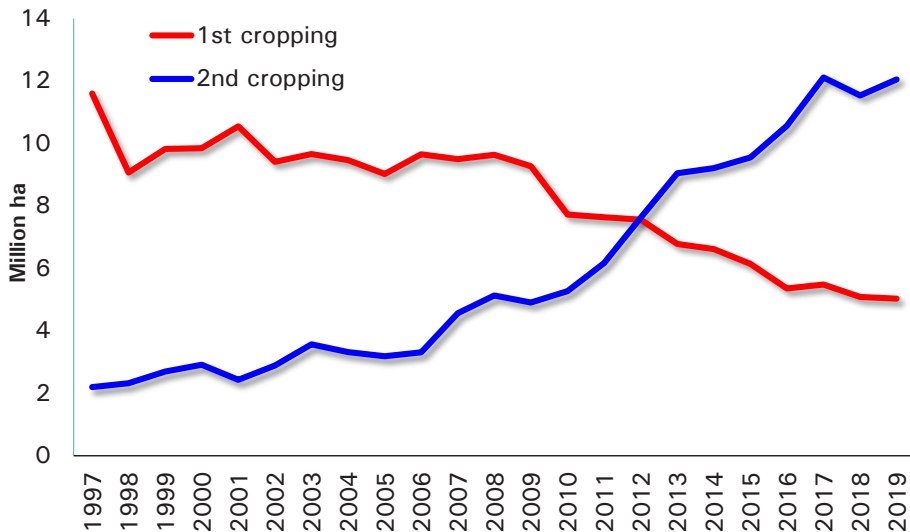
In recent decades, Brazil has primarily incremented its agricultural production in other ways rather than by deforestation and these key drivers will continue for the expansion of the production in the next decades:

- Use of degraded pastures, currently abandoned or underutilized, due to migratory agriculture and former inadequate production systems, a phenomenon that occurred in the country before the 1970's. In the 1990's, Brazilian pasture area reached ca. 220 Mha, 55 Mha more than the present 165 Mha. Even now, it is estimated that ca. 30 Mha represents degraded pastures that can immediately be reincorporated for agricultural purposes (UFG, 2019).
- Conversion of good pastures area to agricultural use, as a result of the continuous improvement of zootechnical parameters and nutritional qua-

lity of pastures, allowing a higher number of cattle heads per hectare and earlier slaughter, meaning that Brazil is continuously producing more meat using progressively less area. It has been estimated that more than 30 Mha of presently used pastures will be available to crops in the next 20 years, regardless of the rate of increase in meat production (Gazzoni; Dall'Agnol, 2018).

- Improvement of pastures by inserting a year of agriculture between several years of occupation with pastures to enable investments in soil improvement, or using a production system called “Integration agriculture-livestock-forest (iLPF in Portuguese)”. This system allows using part of the pasture area for agricultural purposes each year. As for 2016 estimated 11.5 Mha were cropped using the iLPF system (Embrapa, 2019b), and it is surely greater now.
- Agricultural intensification, meaning the use of two, sometimes three cropping cycles a year, in the same area, which implies reducing the area needed for the same agricultural production. The expansion of irrigation can further support the intensification. It is estimated that at least 50% of the Brazilian grain area will be cropped under such approach in the next decades, leading to reduced cropping area.
- Continuous increment of soybean yield supported by technology-based improved productions systems to partially offset the need for additional area.

The Figure 7 is an example of the “area saving” resulting from the agricultural intensification system largely used by Brazilian growers. On the present season (2019) more than 12 Mha will be “saved”, by cultivating maize just after harvesting soybean, on the same area. The former maize area - now used for soybean cultivation during the summer - means the production of over 39 Mt, 50% above the possible amount of soybean that presumably would not be exported by the US to China as a consequence of the tariff war.

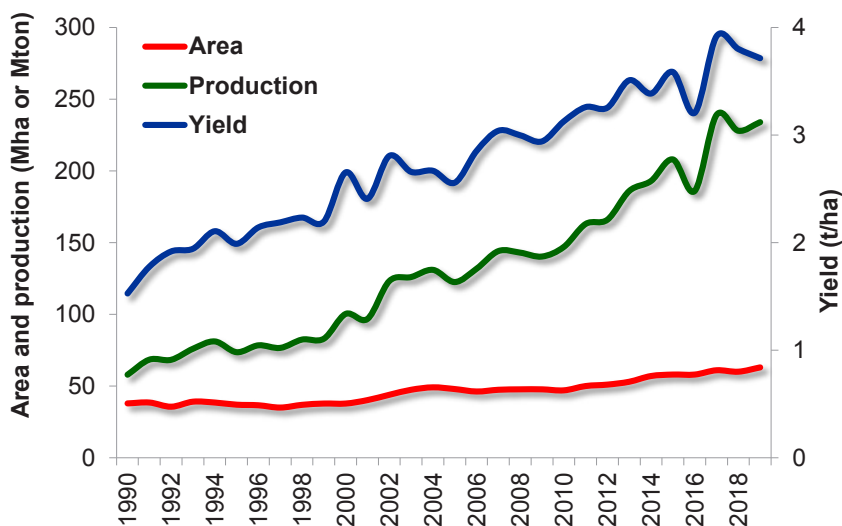


**Figure 7.** Area used for maize production on summer (1<sup>st</sup> cropping) and autumn (2<sup>nd</sup> cropping) in Brazil.

Source: Conab (2019).

## Sustainable agriculture in numbers

The great expansion of Brazilian grain production started at the end of the 1980s. From 1990 to 2019, the production of grains increased 304%, with a yield increment of 145%, while the area expansion was limited to 66% (Figure 8). This way, Brazilian growers demonstrated the feasibility of expanding the agricultural production increasing the crop yields instead of additional lands. This trend will surely remain in the forthcoming years, not only because of legal restrictions, but mainly because growers understood the importance of preserving the environment and because increasing yield is financially more profitable than incorporating new areas, as this option implies in higher investment and production costs. The potential for expansion of soybean cultivation in Brazil has been discussed in more detail in an earlier paper (Cattelan; Dall'Agnol, 2018).



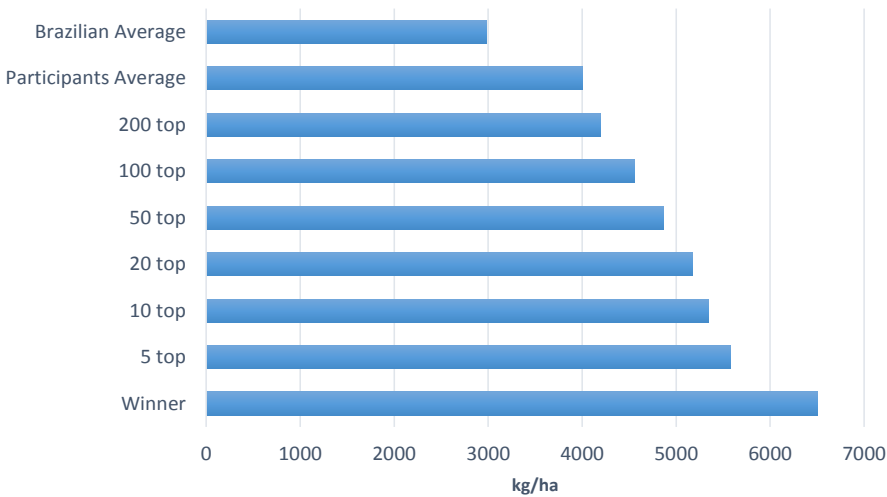
**Figure 8.** Evolution of area, production and yield of grain crops in Brazil.

Source: Conab (2019).

Specifically regarding to soybean yield, the World Bank points out: “[...] agriculture has been an island of success in terms of productivity growth in the last decades compared to other sectors of the Brazilian economy and compared to other country’s agriculture sector” (World Bank, 2019c). Figure 9 presents the results of the Soybean Yield Challenge, conducted by the Brazil Soybean Strategic Committee (CESB) in 2016. Results indicate the availability of commercial technology to achieve higher yields, with improved profitability.

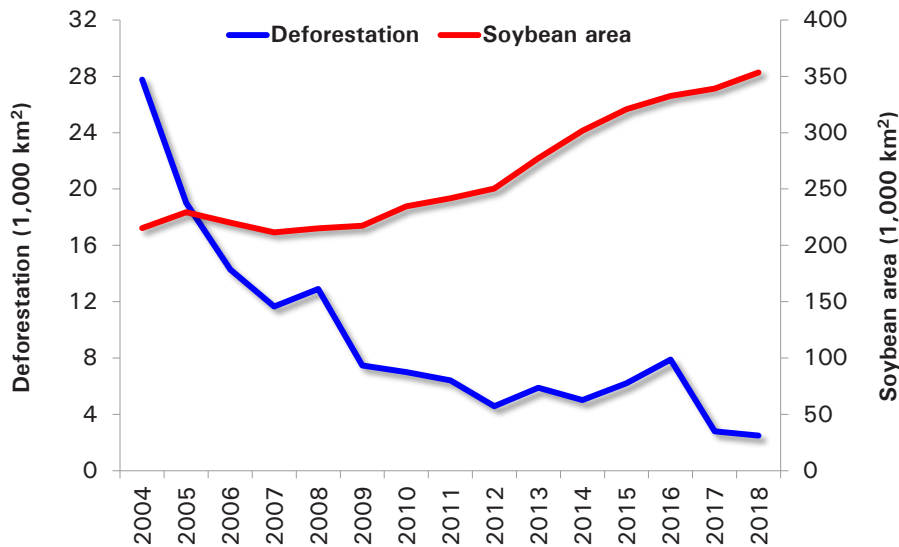
In the 2016/17 Challenge, the winner yield was 117% higher than the Brazilian average soybean yield. The present soybean yield record in Brazil is 8,520 kg/ha, reached in 2015, representing 184% over the average Brazilian soybean yield for that year. These data demonstrate the enormous potential for increasing soybean yield in Brazil, with profitability for the growers.

A quick analysis of the available data comparing deforestation of the Amazon region and the area used for soybean cultivation demonstrates that while the soybean area has expanded from 2005 to 2018, deforestation has reduced (Figure 10). The correlation coefficient between the two series is negative (-0.618).



**Figure 9.** Soybean yield by group of producers participating in the Soybean Yield Challenge (CESB), compared with the winner of the Challenge and with all participants (1,500) for the 2016/17 season.

Source: Gazzoni and Dall’Agnol (2018).



**Figure 10.** Comparison between deforestation in the Amazon forest and the soybean area. ( $r=-0.618$ ).

Source: Gazzoni and Dall’Agnol (2018).

## Brazilian agriculture and reduced GHG emissions

Brazil is a signatory to the UNFCCC Paris Agreement. Accordingly, the country has committed to reduce its greenhouse gas (GHG) emissions by 37% in 2025 and by 43% in 2030 as compared to 2005 (Federative Republic of Brazil, 2015). Data presented at the Climate Conference (COP 24) in Poland showed that in 2018 Brazil had already achieved its goal of reducing greenhouse gas emissions proposed for 2020. The objective was met based on the actions of the forestry sector, which allowed the reduction of 1.28 billion tons of carbon equivalent only in 2018. The country also announced an 11% decrease in deforestation in the Cerrado biome and recovery of areas previously deforested.

In order to reach the above-mentioned targets in the agricultural sector, Brazil has committed to:

- Restore 12 Mha of forests for multiple uses by 2030.
- Restore 15 Mha of degraded pastures and increment by 5 Mha the agriculture-livestock-forest integration systems.
- Enhance the current ABC (Low Carbon Emissions Agriculture) Program (Magalhães; Lima, 2014).
- Enforce the Forest Code Legislation.
- Eliminate illegal deforestation by 2030.
- Compensate the emissions derived from legal deforestation.
- Increment the use of renewable sustainable energy like eolics, solar, and biomass, reaching at least 23% of the electricity generation matrix, by 2030.



Brazil is deeply committed with agricultural production systems involving technologies that reduce the emission of GHG. Among them, it is worth mentioning:

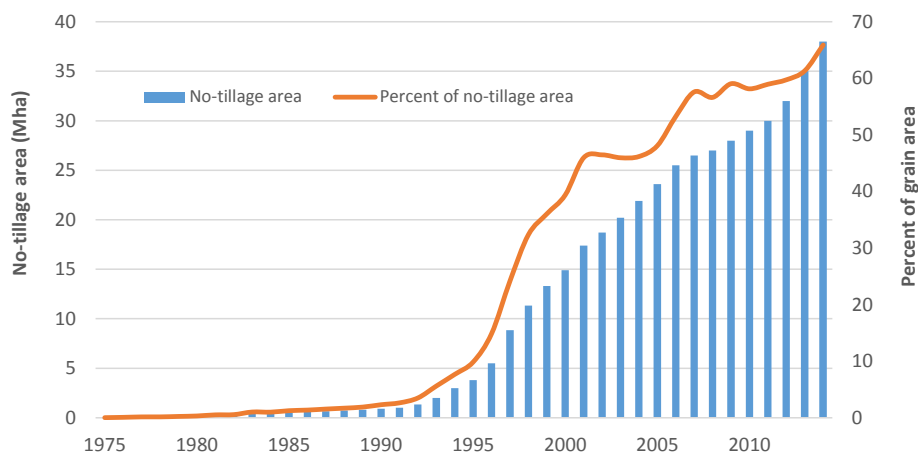
## Biological nitrogen fixation

Brazilian soybean production uses inoculation with nitrogen fixing bacteria (rhizobia), avoiding the use of mineral nitrogen fertilizer. This is the most successful case in the world for the use of microorganisms in agriculture. The trade of inoculants has increased from about 23 million doses in 2010 to 78 million doses by 2018, most of it destined to soybean crop, resulting in an estimated adoption of inoculation ranging from 60 to 90% of the soybean growers, depending on the region. Consistent results have shown that inoculation with *Bradyrhizobium* spp. results in an average yield gain by 8%, whereas the use of recently recommended plant-growth promoting bacteria in co-inoculation, *Azospirillum brasilense*, increases the yield gains by 16% (Hungria et al, 2013a), thus requiring less area for the same production. Considering the soybean area in 2017, the average grain yield, and the GHG emissions that would be necessary for the synthesis and use of mineral N-fertilizers, 62 Mt of CO<sub>2</sub>-equivalent were avoided to be launched into the atmosphere (Hungria et al, 2013b). Replacement of N-fertilizers by biological N fixation decreases not only GHG emissions, but also environmental contamination of stream water and groundwater with nitrites and nitrates (Hungria; Mendes, 2015).

## No-tillage

No-tillage (NT) is the dominant system for grain production in Brazil, occupying almost 70% of the grain-cropped area (Figure 11) and over 90% of soybean area (Gazzoni; Dall'Agnol, 2018).

The estimated average annual rates of soil C-sequestration based on the chronosequence approach were respectively 1.61 and 1.48 Mg C ha<sup>-1</sup> yr<sup>-1</sup> for samplings performed in 2003 and 2011. The accomplishment of the Brazilian Government target to convert an extra 8 million ha of cropland to NT represents an estimated soil C-storage of about 8 Tg C yr<sup>-1</sup> during 10 to 15 years, thus strongly reducing GHG emissions (Corbeels et al., 2016).



**Figure 11.** No-tillage area and percent of the Brazilian grain area cultivated using no-tillage technique.

Source: Gazzoni and Dall'Agnol (2018).

## Reduction of pesticide use

The total amount of pesticides (as active ingredients) used in Brazil in 2015 was estimated in ca. 395.6 kt (Menten, 2016). While agrichemicals use in Brazil grew 14% in the previous five years, grain production increased by 40% in the same period. Consequently, lower quantity is being used per unit of produced grain (1.4 g a.i./kg). Considering the area of grains, coffee, sugarcane, fruits, and vegetables, which consumed 96.8% of the agrichemicals, the annual consumption was 4.99 kg a.i./ha. The available data on consumption of agrichemicals in the world show that Brazil uses a much lesser total amount of products when compared with the world's largest agricultural producing countries (Menten; Banzato, 2016). Less pesticide use represents smaller GHG emissions along the whole chain (synthesis, transportation, application). Field studies carried out directly with growers demonstrated a reduction by 50% in insecticide application for soybean pest control, in farms that followed the technical recommendations for integrated pest management (Conte et al., 2018).

## Conclusions

Based on the facts, data and maps presented, we do not forecast any risk of increasing deforestation rates in the Amazon region, or even in other native vegetation, due to soybean production in Brazil, linked or not to the US-China tariff war.

In order to cope with short or long-term increasing market demands, including the war tariff between China and the US, the Brazilian farmers are able to expand soybean production by increasing yields of current soybean producing areas with available and future technology, and by reclaiming and occupying vast areas of degraded pastures.

In addition, the Brazilian soybean cropping system relies on eco-friendly technologies like biological nitrogen fixation, no-tillage, and pests and diseases integrated managements that increase its sustainability and reduces the emissions of GHG.

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